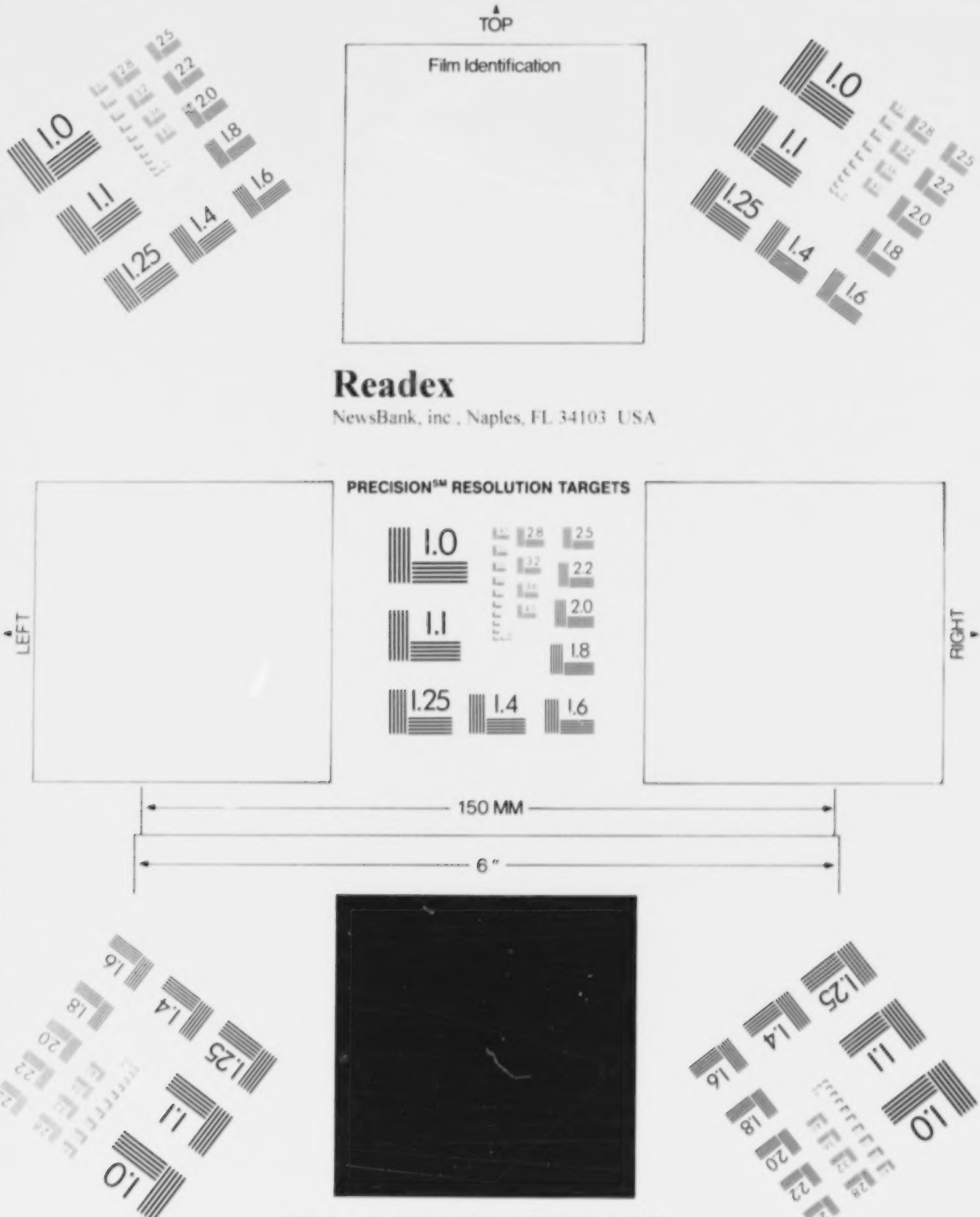

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SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE
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REPORTS ON INTER-SESSIONAL ACTIVITIES

EMISSIONS RESULTING FROM FUEL USED FOR INTERNATIONAL TRANSPORTATION

I. INTRODUCTION

A. Mandate

1. The Kyoto Protocol in Article 2, paragraph 2, states that "Annex I Parties shall pursue limitation and reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO)".

2. The SBSTA, at its tenth session, invited ICAO and IMO to inform it of their work plans relating to emissions based on fuel sold to ships or aircraft engaged in international transport and to provide regular progress reports at future sessions of the SBSTA (FCCC/SBSTA/1999/6, para. 46 (d)).

3. The Conference of the Parties (COP), by its decision 18/CP.5, requested the secretariat to continue to develop its cooperation with ICAO and IMO and to participate in their meetings on climate change related issues (FCCC/CP/1999/6/Add.1).

4. The SBSTA, at the first part of its thirteenth session, encouraged ICAO and IMO to complete their work on this matter as soon as possible. It further noted the importance of coordination by Parties at the national level of their work related to emissions of greenhouse gases from international aviation and shipping under the UNFCCC, ICAO and IMO (FCCC/SBSTA/2000/10, para. 45 (b)).

5. On the issue of reporting international emissions, the SBSTA, at its eleventh session, affirmed that the accuracy, consistency and comparability of data on emissions based upon fuel

sold to ships and aircraft engaged in international transport as reported by Parties need to be improved. The SBSTA welcomed the work of the IPCC on good practices, including those related to the preparation of inventories of emissions based upon fuel sold to ships and aircraft engaged in international transport (FCCC/SBSTA/1999/14, para. 56 (c)).

6. At the same session, it further noted that use of the guidelines for the preparation of national communications by Parties included in Annex I to the Convention, part I: UNFCCC reporting guidelines on annual inventories, including the common reporting format (FCCC/CP/2000/7), would improve the quality of inventory data provided under the Convention. The SBSTA requested the secretariat to include in any report on the experience of Parties using the common reporting format, information on the reporting of emissions based upon fuel sold to ships and aircraft engaged in international transport (FCCC/SBSTA/1999/14, para. 56 (c)).

7. The SBSTA, at its eleventh session, decided to consider the methodological aspects related to emissions based upon fuel sold to ships and aircraft engaged in international transport contained in the IPCC *Report on Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, at the SBSTA session following the approval of that report (FCCC/SBSTA/1999/14, para. 56 (e)).

B. Scope of the note

8. This note provides an overview and update of the activities within ICAO and IMO and by the UNFCCC secretariat related to greenhouse gas emissions from aviation and shipping. It was prepared in collaboration with the IMO and ICAO secretariats, which provided the text for the updates relating to their respective organizations. It replaces the progress reports by these organizations which are due for this session of the SBSTA.

C. Possible action by the SBSTA

9. The SBSTA may wish to take note of the information contained in this document in the preparation of a detailed discussion at the fifteenth session of the SBSTA.

II. CONSIDERATIONS WITHIN IMO

10. **Decision-making structure.** The Marine Environment Protection Committee (MEPC) is responsible for this issue within IMO. It considers any matter within the scope of IMO relating to the prevention and control of marine pollution from ships. It meets approximately every eight months and reports to the Council of IMO.

11. **Past deliberations.** In November 1998, the MEPC decided to prepare a study on greenhouse gases from ships. The task was assigned to a consortium of institutions. The study was presented at the forty-fifth session of the MEPC in September 2000. Due to the heavy workload before the committee, consideration of the study was postponed to the forty-sixth session of the MEPC in April 2001, but a mandate was given to a sub-committee to undertake a technical evaluation of the study. This evaluation noted, *inter alia*, that short-term measures to limit or reduce greenhouse gas emissions may only be introduced on a voluntary basis; long-term measures should only be introduced after careful consideration by the IMO, based on a holistic approach taking into account the cost-benefits to the shipping industry and the development of more detailed global bunker consumption statistics.

12. **Latest conclusions.** The MEPC, at its forty-sixth session in April 2001, decided to form a working group at the next session, which would consider the issue, and to request members to submit written proposals to facilitate the work of the working group. The terms of reference for this working group are:

(a) To evaluate proposals for greenhouse gas emissions reduction contained in the IMO study on greenhouse gas emissions from ships;

(b) To collate and evaluate information submitted by members;

(c) To identify appropriate sub-committees for involvement;

(d) To draw up a work plan; and

(e) To prepare materials for consideration in developing an IMO strategy for greenhouse gas reduction.

13. **Future work.** The MEPC, which includes the working group on greenhouse gases from ships, will meet again in March 2002 for its forty-seventh session.

III. CONSIDERATIONS WITHIN ICAO

14. **Decision-making structure.** The Committee on Aviation Environmental Protection (CAEP) is the expert group responsible for this issue within the ICAO. Established in 1983, it deals with both aircraft noise and aircraft engine emissions. Nineteen ICAO contracting States are members of CAEP and two have observer status. Intergovernmental organizations, industry associations, and environmental non-governmental organizations also participate as observers. CAEP reports to the Council, which is the permanent governing body of ICAO and is composed of 33 contracting States elected by the ICAO Assembly for 3 years. The Council is responsible to the Assembly, which is the sovereign body of ICAO and includes all 187 contracting States. The next meeting of the Assembly is in September 2001.

15. **Past deliberations.** ICAO had requested the IPCC in 1996 to prepare a report on the atmospheric impact of aircraft engine emissions. This report, which was prepared in collaboration with the Scientific Assessment Panel to the Montreal Protocol, with some technical input from ICAO, was published in 1999.[1]

16. The CAEP at its fourth meeting in 1998 established three working groups to consider different aspects of aircraft engine emissions, namely further development of technology and related world-wide standards, reducing fuel burn through improved operational measures, and exploring the potential role of market-based options. These groups met regularly and prepared information for consideration by the CAEP at its fifth meeting.

17. **Latest conclusions.** At its fifth meeting, in January 2001, the CAEP reviewed progress.

(a) On technology and standards, the CAEP endorsed continuing methodological work on calculating emissions in the climb and cruise phases of flight. It decided not to pursue

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[1] Intergovernmental Panel on Climate Change, "Aviation and the global atmosphere", Cambridge University Press, 1999, ISBN 0-521-66404-7.

the possibility of an ICAO standard limiting carbon dioxide, concluding that this would be very difficult in view of the great diversity of operations and noting that market pressures already ensured that aircraft are very fuel-efficient.

(b) On operational measures, the CAEP endorsed guidance material on operational opportunities to minimize fuel use and reduce emissions, for publication by ICAO. It also endorsed a methodology for estimating fuel savings and reductions in emissions to be derived from implementing new satellite-based Communications, Navigation, Surveillance and Air Traffic Management (CNS/ATM) systems. This methodology is now being included in ICAO's Global Air Navigation Plan and steps are being taken to promote awareness of the environmental benefits associated with CNS/ATM implementation.

(c) On market-based options, the CAEP discarded closed emissions trading as an option and called for further work on the development of an open emissions trading system for international aviation. ICAO would play a leadership role, particularly regarding proposals for caps. Voluntary agreements could be a first stage to encourage near-term action, as a lead-in to a future regime. Charges are considered as shorter-term options on which further work is also needed.

18. A CAEP Action Plan on Aircraft Engine Emissions was approved and a new work programme for the CAEP and its working groups was adopted. This gives high priority to the development of guidance on voluntary mechanisms, identification and calculation of emissions related costs and their application, and how revenues could be distributed. The CAEP is urged to coordinate with UNFCCC on any process to link an open emissions trading system to the Kyoto mechanisms; it is also urged to consider possible targets for aviation and to develop the key elements of an emissions trading system. The effects of the options on developing countries would be further studied.

19. In March 2001, the Council reviewed the results of CAEP 5, noted the CAEP Action Plan and approved the new work programme for the CAEP.

20. **Future work.** In September, the Council will report to the ICAO Assembly on the progress made on greenhouse gas emissions. The Council will also present proposals to update Assembly Resolution A32-8 (Consolidated statement of continuing ICAO policies and practices related to environmental protection), in the light of the above conclusions.

21. The CAEP working groups will continue to meet regularly to pursue the new CAEP work programme.

IV. ACTIVITIES BY THE UNFCCC SECRETARIAT

22. The UNFCCC secretariat attended several meetings of ICAO and IMO. It made several presentations on the status of the climate change negotiations. The UNFCCC secretariat also provides and maintains a web page on the issue, where further information can be found, for example, the full text of the IMO study on greenhouse gases from ships.[2]

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[2] http://www.unfccc.int/issues/emissres.html

23. Issues related to the quality of reporting of emissions from international bunker fuels are being addressed in the current trial period for the technical review of inventories (decision 6/CP.5). The IPCC good practice guidance contains further information on methods to estimate emissions from fuel sold for international transport.[3] A report on the use of the reporting guidelines for annual inventories, including the common reporting format, and the use of the IPCC good practice guidance, as mandated by decision 5/CP.5 and the SBSTA at its twelfth session, will be made available by the secretariat at the fifteenth session. This report will include information on the reporting of emissions from international bunker fuels.

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[3] Information on methods to estimate emissions from fuel sold for international transport may be found in chapter 2, pages 2.51 to 2.69. The full report is available on the IPCC web site at http://www.ipcc-nggip.iges.or.jp/public/gp/gpgaum.htm. Annex I Parties have been urged, to the extent possible, to apply the IPCC good practice for inventories due in 2001 and 2002 and use it for inventories due in 2003 and beyond. Annex I Parties with economies in transition may phase in the good practice guidance two years later than other Annex I Parties.

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SCIENTIFIC AND METHODOLOGICAL ASPECTS OF THE PROPOSAL BY BRAZIL

Progress report on the review of the scientific and methodological aspects of the proposal by Brazil

Note by the secretariat

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I. INTRODUCTION

A. Mandate

1. The Conference of the Parties (COP), at its third session, decided that the proposal presented by Brazil in document FCCC/AGBM/1997/MISC.1/Add.3 should be referred to the Subsidiary Body for Scientific and Technological Advice (SBSTA) for its advice regarding the methodological and scientific aspects. It authorized the SBSTA to seek inputs, as appropriate, from its roster of experts and from the Intergovernmental Panel on Climate Change (IPCC), and requested it to make its advice available to the COP at its fourth session (FCCC/CP/1997/7, para. 69).

2. The SBSTA, at its eighth session, noted that the portion of that proposal referring to a clean development fund had now been overtaken by decisions taken by the COP at its third session, in particular, the provision for a clean development mechanism as defined in Article 12 of the Kyoto Protocol, that Protocol's Annex B and decision 1/CP.3 on the adoption of the Kyoto Protocol. The SBSTA recognized that there were a number of methodological and scientific issues raised by the remainder of the proposal and that these were still being investigated by scientists in several countries. The SBSTA welcomed the offer by the delegation of Brazil to host a workshop to further the understanding of the methodological and scientific aspects of the remainder of the proposal (FCCC/SBSTA/1998/6, para. 51).

3. The SBSTA, at its ninth session, noted the information provided by Brazil on recent scientific activities and on the workshop to be organized regarding the proposal presented by Brazil in document FCCC/AGBM/1997/MISC.1/Add.3. The SBSTA also noted the potential contribution of other relevant analyses to increase understanding of the methodological and scientific aspects of this proposal. The SBSTA invited the delegation of Brazil to inform the SBSTA at its tenth session, of the results of its workshop and to provide it with other relevant information (FCCC/SBSTA/1998/9, para. 29).

4. The SBSTA, at its eleventh session, took note of the information provided by the delegation of Brazil, including a revised version of the methodology originally proposed in document FCCC/AGBM/1997/MISC.1/Add.3. The SBSTA commended Brazil for its work on this subject. The SBSTA also noted that the IPCC Third Assessment Report is likely to contain the best available information related to the values of the parameters and other material relevant to the assessment of the proposal. It also noted the need for further scientific analyses.

5. At the same session, the SBSTA further requested the secretariat to coordinate a review of this proposal by experts selected from the roster of experts, to be completed in time for its fourteenth session. It also requested the secretariat to make the information provided by the experts available on its web site.

6. Furthermore, the SBSTA invited the delegation of Brazil and other Parties to send to the secretariat information on the scientific and methodological aspects of, and related information on, the Brazilian proposal and requested the secretariat to make this information available on its web site for use by experts (FCCC/SBSTA/1999/14, para. 63).

B. Scope of the note

7. This document contains background information on the proposal by Brazil and its past consideration in section II, the conclusions of the expert meeting on its review in section III and a discussion on possible next steps in section IV.

C. Possible action by the SBSTA

8. The SBSTA may wish to take note of information provided in this document and to provide guidance on what additional aspects of the proposal by Brazil need further consideration and how these issues should be addressed.

II. BACKGROUND

A. The proposal by Brazil

9. During the negotiations of the Kyoto Protocol in 1997, the delegation of Brazil made a proposal for distributing the burden of emission reductions among Parties included in Annex I to the Convention (Annex I Parties) (FCCC/AGBM/1997/MISC.1/Add.3):

(a) The proposal suggested that reductions towards an overall emission ceiling for all Annex I Parties (30 per cent below 1990 levels by the year 2020) were to be shared among individual Annex I Parties proportional to their relative share of responsibility for climate change;

(b) The original paper presented by Brazil in 1997 proposed an approach for estimating the relative share of responsibility for climate change of different Annex I Parties, based on their contribution to the increase of global-average surface temperature over a certain period of time;

(c) The proposal suggested using an agreed simple climate model for estimating the temperature increase resulting from emissions of different countries. As an illustration, the original proposal in 1997 included a calculation using a "policy-maker model" for such estimation;

(d) The proposal also contained a penalty mechanism called the "clean development fund". It was to be supported by requiring non-complying Annex I Parties to pay a financial penalty for every ton of carbon above their target. The revenue was to be used to fund projects for Parties not included in Annex I to the Convention (non-Annex I Parties).

B. Past considerations of the proposal

10. The delegation of Brazil organized an informal meeting on the evaluation of the Brazilian proposal during the fourth session of the COP in November 1998, for which it made available an update of the calculation method for estimating the temperature increase from emissions. Furthermore, the delegation of Brazil organized an expert meeting on the Brazilian proposal, "Scientific aspects and data availability", held from 19 to 20 May 1999 in Cachoeira Paulista, Brazil.

11. At the tenth session of the SBSTA in November 1999, the delegation of Brazil made available a further update of the calculation method for estimating the temperature increase from emissions. The latest version, dated January 2000, is available from the Ministry for Science and Technology, Brazil, on its web site.[1]

III. PREPARATION OF THE REVIEW

12. During the thirteenth session of the SBSTA in September 2000, the secretariat distributed a letter to all Parties asking for further nominations to the roster of experts, since only a limited number of experts had been nominated for the review of the proposal by Brazil. Subsequently, only a few additional nominations were received.

13. At its eleventh session, the SBSTA had invited the delegation of Brazil and other Parties to send to the secretariat information on the scientific and methodological aspects of, and related information on, the Brazilian proposal and had requested the secretariat to make this information available on its web site for use by experts. No such submissions were received.

14. To initiate the review of the proposal, the secretariat organized an expert meeting from 28 to 30 May in Bonn, Germany. Fourteen experts from the scientific community attended. The experts were selected in consultation with the Chairman of the SBSTA and the Chairman of the IPCC. The meeting was chaired by Mr. Bert Metz of the Netherlands. The list of participants is contained in annex I to this document.

15. Relevant information on the proposal is available from the UNFCCC web site, including the proposal itself, the update of the calculation method by Brazil, detailed information on the expert meeting and information provided by the experts.[2]

IV. CONCLUSIONS OF THE EXPERT MEETING

A. General

16. The primary focus of the expert meeting was to identify issues relating to the scientific and methodological aspects of the Brazilian proposal, including those that need further consideration and areas of future work.

17. Several experts noted that there are other approaches to estimate the relative share of responsibility for climate change. The scientific and methodological aspects of those other approaches were not discussed at the expert meeting.

18. The expert meeting did not undertake a review of other aspects of the original paper as referred to in paragraph 9 (a) and (d) above and it did not undertake a discussion of policy issues. The participants noted that the way in which calculations are to be applied could influence future scientific and methodological improvements to calculations. For example, the current model by Brazil does not include aerosols and tropospheric ozone as these were not under discussion at the time the Kyoto Protocol was being negotiated. If policy makers decide to include aerosols and

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[1] http://www.mct.gov.br/clima. Hard copies may be obtained from: Ministerio da Ciência e Tecnologia, Gabinete do Ministro, Esplanada dos Ministérios, Bloco E - 3 Andar - Sala 398, 70067-900 Brasília, Brazil.

[2] http://www.unfccc.int/issues/brazil.html

tropospheric ozone - and their precursors - in a basket of pollutants to be mitigated in the future, the calculation would need to be revised accordingly.

19. It was noted that future considerations of the proposal would be enhanced if the Government of Brazil were to make available a written report on the current version.

B. Methods to calculate the relative responsibility for climate change

20. To calculate the relative responsibility for climate change one needs to consider the cause-effect chain which leads from emissions of greenhouse gases to changes in climate: emissions of greenhouse gases, precursors and aerosols change the concentration of these and other gases in the atmosphere. Changed concentrations influence the radiative forcing.[3] Changed radiative forcing influences the global-average surface temperature with a certain time delay. The absolute change in temperature, as well as the rate of its change, influences the sea level and other parameters such as precipitation and related damages.

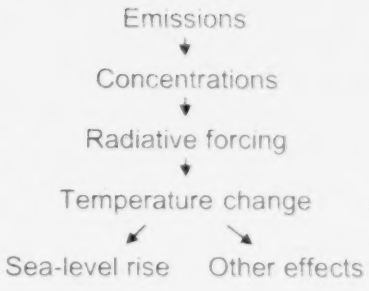

Figure 1: Cause-effect chain used to estimate relative responsibility for climate change

21. The "policy-maker" model of 1997 assumed that the temperature increase is proportional to the time integral of the radiative forcing. This assumption is only valid for very short periods and this aspect of the model was later corrected. In addition, it was modified to account for non-linearities in the carbon cycle and in the relation between concentrations and radiative forcing. As a consequence of the inclusion of non-linearities, the latest version attributes climate change to different sources using a differential or marginal approach.

22. Further, the rates of temperature change and mean sea-level rise were added as global variables that could be considered as a basis for attribution in addition to the temperature increase.

1. General conclusions on the method

Choice of the index to be used as a measure of the effect of emissions on climate change

23. The experts concluded that indices along the cause-effect chain, such as current emissions, cumulative historical emissions, concentration levels, radiative forcing, global mean surface temperature increase, rate of temperature change and sea-level rise can be calculated and attributed to different sources of emissions. Different indices would lead to different relative attributions.

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[3] Radiative forcing is a measure of the influence a factor, such as increased concentrations, has in altering the balance of incoming and outgoing energy in the earth-atmosphere system.

24. The attribution estimates derived from an index further down the cause-effect chain from emissions to climate change would in most cases be more uncertain because of the cumulative uncertainties, but some individual uncertainties (e.g., in very early emissions) are damped as one progresses down the cause-effect chain.

25. Indices of the cause-effect chain from concentrations onwards, taken at a particular point in time, do not take into account "unrealized warming", that is, the effect of the emissions up to the particular point in time on climate changes thereafter. This concern can be addressed by evaluating these indices for any time after that point, assuming emissions had stopped at that particular point in time.

26. Regarding future work, it was recommended that additional analyses be undertaken to calculate the relative contribution to climate change of different sources according to different indices, and to examine the sensitivity of the attribution estimates to different indices at different times. For these comparisons, it would be helpful to define common input data (i.e., historical emissions).

Non-linearities

27. The experts noted that emissions of greenhouse gases at one point in time have a different effect on concentrations, radiative forcing and temperature than if the same quantity is emitted at another point in time, due to the changing composition of the atmosphere and changing atmospheric processes. If this non-linear effect is taken into account, the attribution of "early" and "late" emitters will be different. This can be handled mathematically by working on the margin, derivative or tangent. Using this approach, the individual attribution estimates may not add up to the estimate calculated from all emissions. This effect can be compensated by normalizing the individual contributions to the total.

Displaying of results

28. The experts concluded that it would be useful to put the attribution estimates in the context of other socio-economic indicators, such as population or economic output.

Use of climate models

29. The experts concluded that several existing simple climate models could be used in the calculation of the attribution. Such models simulate the real concentration and temperature records. Validation of the models used for the attribution through the simulation of the observed record of atmospheric composition and climate change is seen as essential.

30. Regarding future work, it was recommended that several existing simple climate models be used to prepare attribution calculations with harmonized input parameters in an open and transparent process. A condition for participating in such a process would be that the code of the participating models is made available.

Uncertainty of the attribution calculation

31. The experts noted that the overall uncertainty is a function of the individual uncertainties of each step of the cause-effect chain.

32. Regarding future work, it was recommended that the overall uncertainty of the attribution calculations should be estimated.

Different scenarios

33. The experts noted that the use of different future emissions scenarios would influence the results of the attribution estimates for points in time in the future.

34. Regarding future work, it was recommended that the emission scenarios contained in the IPCC Special Report on Emission Scenarios be used to examine the sensitivity of the attribution estimates to different scenarios.

2. Emissions to concentrations

Data sources for historic emissions

35. The experts noted that it is possible to calculate the attribution of emissions from any year onwards, given data availability and data accuracy. The original proposal by Brazil included calculations for starting years 1840 and 1990.

36. The experts concluded that data on all greenhouse gases from the year 1990 onwards are sufficiently reliable and detailed to make attribution estimates. Before 1990 there are much larger uncertainties. Land-use change and forestry data in particular need major improvement, as does the inventory for aerosols other than sulfate. All greenhouse gases included in Annex A to the Kyoto Protocol should be included in the analysis. For the purpose of model validation and acceptance by the community, the full range of greenhouse gases and aerosols that contribute significantly to climate change need to be included. For points in time in the future, this full range needs to be included to make accurate attribution estimates.

37. Regarding future work, it was recommended that analyses should be undertaken to compare attribution estimates based on different starting dates for a variety of countries for carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), and to examine the sensitivity of the attribution estimates to the uncertainty range of the historic data.

Carbon dioxide (CO_2)

38. It was concluded that all sources of CO_2 be used in the analyses and that a number of carbon cycle models be used to capture the full possible range and the feedback on the cycle due to temperature change and CO_2 fertilization effects.

39. Regarding future work, it was recommended that the impact of climate feedbacks on the carbon cycle in the future under different scenarios contained in the IPCC Special Report on Emission Scenarios be examined.

Methane (CH_4)

40. The experts noted that the levels of hydroxyl radicals (OH) and the indirect effect of methane on tropospheric ozone are significant for the total radiative forcing caused by methane emissions. Historic levels of OH are not available, so that this effect can only be represented by a factor in making the calculations (see also paragraph 43). Similarly, the indirect effect on

tropospheric ozone can also be represented as a factor in the calculations. These factors have an uncertainty range, which decreases from the past to the present and which influences the total uncertainty of the attribution results. The experts noted that the additional tropospheric ozone due to methane emissions is only a fraction of the total greenhouse effect caused by tropospheric ozone.

Aerosols

41. The experts noted that some historic data on precursors of sulphate aerosols (i.e., SO_2) from fossil fuels are available, but the uncertainties are not characterized. Historic data on non-sulphate aerosols from fossil fuels and aerosols from biomass are not available. The inclusion of aerosols in the attribution calculation would change the relative contribution of sources. Aerosols are not covered by the Kyoto Protocol. Descriptions of the atmospheric processes induced by aerosols are available. Their inclusion would allow the total change in concentration and temperature calculated to be validated against historic records, a useful feature even if aerosols are not included in the attribution calculations.

Carbon monoxide (CO) and oxides of nitrogen (NO_x)

42. The experts noted that CO and NO_x have an indirect effect on temperature through their effect on OH levels, which subsequently influence methane concentrations and on tropospheric ozone. However, CO and NO_x are not covered by the Kyoto Protocol. Inclusion of the effects of these gases in the attribution would change the relative contribution of sources. Descriptions of the atmospheric processes induced by CO and NO_x are available. Their inclusion would allow the total change in concentration and temperature calculated to be validated against historic records, a useful feature even if CO and NO_x are not included in the attribution calculations.

Hydroxyl radicals (OH)

43. The experts noted that the levels of OH have an effect on temperature by altering lifetimes of CH_4 and hydrofluorocarbons (HFCs). The level of OH in the atmosphere is a function of emissions of CH_4, NO_x, CO and volatile organic compounds (VOCs). Since national emissions data of NO_x, CO and VOCs for years prior to 1990 are not available, only the effect on methane can be approximated for attribution calculations prior to 1990 (see paragraph 40 above). For attribution post 1990 it would be possible to use information on emissions of CH_4, NO_x, CO, VOCs and OH concentrations.

Tropospheric ozone

44. The experts noted that tropospheric ozone is formed in the atmosphere from precursor emissions of CH_4, NO_x and CO. Tropospheric ozone is a greenhouse gas and therefore has an effect on temperature. Tropospheric ozone is not covered by the Kyoto Protocol. Attribution to emitters of CH_4, NO_x and CO is not possible for years prior to 1990.

3. Concentrations to radiative forcing

45. The experts concluded that any attribution calculation of CO_2 and CH_4 should include the non-linearities due to the saturation of the absorption bands as described in the IPCC Third

Assessment Report (TAR). The overlap of the absorption lines of N_2O and CH_4 is much less significant but can be included as described in the IPCC TAR for completeness.

4. Radiative forcing to temperature increase

46. The experts noted that several parameterizations and models of the relationship between radiative forcing and changes in global-average surface temperature are available.

47. Regarding future work, it was recommended that the sensitivity of the attribution estimates to the different parameterizations and models of the temperature response be examined.

5. Temperature increase to sea-level rise

48. The experts noted that several parameterizations and models of the relationship between the global-average surface temperature and sea-level rise are available. Calculations should include a range of model parameters and all contributions, including those other than thermal expansion.

49. Regarding future work, it was recommended that the sensitivity of the attribution results to the different parameterizations and models of the response of the sea level to increased temperature be examined.

6. Radiative forcing to rate of change of the temperature

50. The experts concluded that the rate of temperature change is a potentially useful indicator and should be considered in calculating the attribution as the time derivative of the temperature (see paragraph 23).

7. Temperature increase to damages

51. The experts noted that the attribution of damages to sources of emissions would be different from the attribution of temperature increase to the same sources, since the damages may not be directly proportional to the increase in temperature. Damages are likely to increase faster than temperature increases. The quantification of damages is extremely difficult. Aggregated damage functions may not be calculated objectively. Damages from extreme weather events could be particularly important, but there is no readily available method to make such global estimates. Damages from catastrophic changes could increase considerably with small additional changes in the temperature, making the attribution to individual sources very difficult.

52. Regarding future work, it was recommended that the sensitivity of the attribution results to the different available damage functions be examined.

V. POSSIBLE NEXT STEPS

53. At the expert meeting, views differed on which issues should be included under "scientific and methodological aspects". While some participants thought that only the calculation method to attribute responsibility for climate change to emission sources should be included, others favoured a broader approach.

54. The previous section contains a number of recommendations relating to specific aspects of the Brazilian proposal that could be addressed in the future. Several experts indicated they are

willing to cooperate to make this happen, but this would require some financial resources. Most importantly, however, there is a need to ensure that future scientific work is designed to address the needs of the Parties.

55. Parties may wish to provide views on the following possible next steps.

(a) To initiate a research effort to develop a database of emissions and scientific parameterization and then to perform the calculations recommended by the experts;

(b) To request the secretariat to organize an expert meeting after several research groups have performed the recommended calculations, to compare the results;

(c) To establish a process for continuing the exchange of scientific and technical information on aspects of the proposal by Brazil that need further consideration, taking into account the policy needs of the Parties.

Annex

LIST OF PARTICIPANTS

Mr. Richard BALL
Consultant
United States of America

Mr. Harald DOVLAND
SBSTA Chairman
Ministry of Environment
Norway

Sr. Carlos ERENO
Professor
Comision Nacional para el Cambio
University of Buenos Aires
Argentina

Mr. Philip M. GWAGE
Assistant Commissioner for Meteorology
Department of Meteorology
Uganda

Mr. Geoff JENKINS
Head
Climate Prediction Programme
Hadley Centre for Climate Prediction and
Research
United Kingdom of Great Britain and
Northern Ireland

Mr. Luiz Gylvan MEIRA FILHO
President of the Brazilian Space Agency
Brazilian Space Agency
Brazil

Mr. Bert METZ
Co-Chairman IPCC WGIII
Department of International Environmental
Assessment, Bureau of Environmental
Assessment
Rijksinstituut voor Volksgezondheid en
Milieuhygiene (RIVM)
The Netherlands
Mr. Jose D. GONZALEZ MIGUEZ
General Coordinator on Global Change
Ministerio da Ciencia e Technologia
Brazil

Mr. Nebojsa NAKICENOVIC
Project Leader
Environmentally Compatible Energy
Strategies
International Institute for Applied Systems
Analysis
Austria

Ms Joyce E. PENNER
IPCC Lead Author
Atmospheric Oceanic and Space Sciences
University of Michigan
United States of America

Mr. Jonathan C. PERSHING
Division Head for Energy and Environment
International Energy Agency
France

Mr. Luiz PINGUELLI ROSA
Representative of the Brazilian Society for
Science Development (SBPC)
Universidad Federal do Rio de Janeiro
Brazil

Mr. Michael PRATHER
Professor
Earth System Science Department
University of California, Irvine
United States of America

Mr. Bang Zhong WANG
Division Director
Department of Prediction and Disaster Mitigation
China Meteorological Administration
China

UNFCCC secretariat

Mr. Michael ZAMMIT CUTAJAR
Executive Secretary

Mr. Dennis TIRPAK
Coordinator, Science and Technology

Mr. Niklas HOHNE
Programme Officer

Invited but unavailable experts:

Mr. Thomas BLACK-ARBELAEZ
Independent Adviser
Colombia

Mr. Ogunlade DAVIDSON
Energy & Development Research Centre
South Africa

Mr. Michel DEN ELZEN
Rijksinstituut voor Volksgezondheid en Milieuhygiene (RIVM)
The Netherlands

Mr. Jae EDMONDS
BATELLE Pacific North West Laboratories
Unites States of America

Mr. Ian ENTING
CISRO
Australia

Mr. James HANSEN
NASA
United States of America

Mr. Bill HARE
Greenpeace International
The Netherlands

Mr. Fortunat JOOS
University of Bern
Switzerland

Mr. Benito MUELLER
Oxford Institute for Energy Studies
United Kingdom of Great Britain and Northern Ireland

Mr. Rajendra PACHAURI
Tata Energy Research Institute
India

Mr. Colin PRENTICE
Max-Planck Institute
Germany

Mr. Hans-Joachim SCHELLNHUBER
Potsdam Institute for Climate Impact Research
Germany

Mr. Robert SCHOLES
Council for Scientific and Industrial Research
South Africa

Yap Kok SENG
Malaysian Meteorological Service
Malaysia

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Item 6 of the provisional agenda

COOPERATION WITH RELEVANT INTERNATIONAL ORGANIZATIONS

Issues related to the Convention on Biological Diversity

Note by the secretariat

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Recommendation VI/7 of the Subsidiary Body for Scientific, Technical and Technological Advice of the Convention on Biological Diversity 5

I. INTRODUCTION

A. Mandate

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at the second part of its thirteenth session, took note of the decisions of the fifth meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD) relating to forest biodiversity and marine and coastal biodiversity, particularly coral reefs, and their links to the United Nations Framework Convention on Climate Change (UNFCCC).[1] The SBSTA agreed to consider this matter in more detail at its fourteenth session. It invited Parties to submit their views on the issues identified in the discussion note[2] prepared by the Executive Secretary of the CBD to the UNFCCC secretariat no later than 1 March 2001, to be included in a miscellaneous document (see FCCC/SBSTA/2000/14, para. 60).

B. Scope of the note

2. This note presents information in response to the above mandate. The information is intended to assist Parties in considering how to proceed further with issues relating to cooperation between the CBD and the UNFCCC.

3. The note provides some background information based on the discussion note by the Executive Secretary of the CBD, as presented to the SBSTA at the second part of its thirteenth session, and a note by the Executive Secretary of the CBD, as presented to the Subsidiary Body for Scientific, Technical and Technological Advice (SBSTTA) of the CBD at its sixth session.[3] On the basis of these documents, and taking into account views submitted by Parties on the discussion note contained in document FCCC/SBSTA/2001/MISC.3, the present note identifies questions needing consideration by the SBSTA.

C. Possible action by the SBSTA

4. The SBSTA may wish to take note of and provide guidance on issues identified in this paper. Parties may wish to come prepared with suggestions on cooperation between the CBD and the UNFCCC.

II. BACKGROUND

5. The Conference of the Parties to the Convention on Biological Diversity (CBD), at its fifth meeting, considered the interactions between climate change and the conservation and sustainable use of biological diversity in a number of thematic and cross-cutting areas, including coral bleaching, forest biodiversity and incentive measures, and urged strengthened cooperation with the UNFCCC.[4] Specifically, the SBSTTA was requested to consider the impact of climatic

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[1] Decisions V/3, V/4, V/15 and V/21, also available on the CBD web site at http://www.biodiv.org

[2] UNEP/CBD/SBSTTA/6/11, annex I.

[3] UNEP/CBD/SBSTTA/6/11.

[4] See footnote 1.

change on forest biological diversity[5] and to prepare scientific advice in order to integrate biodiversity considerations into the implementation of the UNFCCC and its Kyoto Protocol.[6] In both cases the Conference of the Parties to the Convention on Biological Diversity called for this work to be carried out in collaboration with the appropriate bodies of the UNFCCC and the Intergovernmental Panel on Climate Change (IPCC), where appropriate and feasible.

6. The Executive Secretary of the CBD made available a discussion note to the SBSTA, at the second part of its thirteenth session on the interaction between climate change and biological diversity.[7] The SBSTA took note of the information and invited Parties to submit views on the discussion note to the secretariat by 1 March 2001 (FCCC/SBSTA/2000/14, para. 60). The secretariat received four such submissions from Parties; these are contained in document FCCC/SBSTA/2001/MISC.3.

7. The SBSTTA of the CBD addressed the issue of biological diversity and climate change at its sixth meeting. To assist the SBSTTA in its task, the Executive Secretary of the CBD prepared a note,[8] providing a progress report on activities, including collaboration between the CBD, the UNFCCC and the IPCC, and identifying relevant areas of scientific guidance. It also included the discussion note to the UNFCCC referred to in paragraph 6 above (see also attached annex), and a brief review of the relationship between climate change and biological diversity.[9]

8. At the same meeting, the SBSTTA of the CBD, agreed, among other conclusions, to undertake a pilot assessment to prepare scientific advice to integrate biodiversity considerations into the implementation of the UNFCCC and its Kyoto Protocol. For this purpose, also at the same meeting, the SBSTTA established an ad hoc technical expert group. This would be part of a wider assessment of the interlinkages between biological diversity and climate change. The pilot assessment will address the following issues:

(a) The impacts of climate change on biological diversity and the impacts of biodiversity loss on climate change;

(b) The potential impact on biological diversity of mitigation measures that may be carried out under the UNFCCC and its Kyoto Protocol, and identification of potential mitigation measures that also contribute to the conservation and sustainable use of biological diversity;

(c) The potential for the conservation and sustainable use of biological diversity to contribute to climate adaptation measures.

9. The SBSTTA invited the UNFCCC and other relevant organizations to contribute to this assessment. It further invited the IPCC to contribute by preparing a technical paper and by identifying experts (UNEP/CBD/COP/6/3, paras. 5-9).[10]

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5 Decision V/4, para. 11.

6 Decision V/4, para. 18.

7 UNEP/CBD/SBSTTA/6/11, annex I.

8 UNEP/CBD/SBSTTA/6/11.

9 UNEP/CBD/SBSTTA/6/11, annex II.

10 Recommendation VI/7.

10. The SBSTTA further requested the Executive Secretary of the CBD, in consultation with the secretariat of the UNFCCC, to explore the formation of a joint liaison group between the bureau members of the relevant subsidiary bodies of the UNFCCC and the CBD, and their respective secretariats. The purpose of the liaison group would be to enhance coordination between the two conventions including exchange of relevant information, development of a joint work plan to address the interlinkages between climate change and biological diversity, and the organization of a joint workshop to further cooperation between the two conventions. (For the complete text of the SBSTTA recommendation VI.7, please see the annex below.)[11]

11. The Chairman of the SBSTA and the secretariat coordinator responsible for the SBSTA attended the sixth meeting of the SBSTTA. Informal discussions were held with the Executive Secretary of the CBD and the Chairman of the SBSTTA. An additional informal meeting is planned on the margins of the fourteenth session of the SBSTA.

12. In response to the request by the SBSTTA, as referred to in paragraph 9 above, the IPCC, at its seventeenth session, agreed to prepare a scoping paper[12] in time for the fourteenth session of the SBSTA. A final decision on scope, outline and selection of authors will be taken at the eighteenth session of the IPCC.

III. QUESTIONS NEEDING CONSIDERATION

13. The SBSTA may wish to consider whether it should:

(a) Contribute to the pilot assessment, to be undertaken by an ad hoc technical expert group of the SBSTTA, on integrating biodiversity considerations into the implementation of the UNFCCC and its Kyoto Protocol and, if so, in which manner;

(b) Join with the SBSTTA and endorse the request to the IPCC for a technical paper and, if so, give the IPCC suggestions relating to the contents of this paper;

(c) Provide the secretariat with guidance relating to the formation of a joint liaison group between the bureau members of the relevant subsidiary bodies of the UNFCCC and the CBD and their respective secretariats;

(d) Consider cooperation with other relevant organizations in this context and, if so, what specific issues should be considered, and in which manner they should be dealt with.

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[11] Further information is available on the CBD web site at http://www.biodiv.org/cross-cutting/climate

[12] The IPCC secretariat has indicated that the scoping paper will be available at the fourteenth session of the SBSTA.

Annex[1]

RECOMMENDATION VI/7 OF THE SUBSIDIARY BODY FOR SCIENTIFIC, TECHNICAL AND TECHNOLOGICAL ADVICE OF THE CONVENTION ON BIOLOGICAL DIVERSITY

BIOLOGICAL DIVERSITY AND CLIMATE CHANGE, INCLUDING COOPERATION WITH THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

The Subsidiary Body on Scientific, Technical and Technological Advice,

Recalling decisions V/3, paragraphs 3, 5 and annex, V/4, paragraphs 11 and 16-20, V/15, paragraph 6, and V/21, paragraph 3, of the Conference of the Parties,

Emphasizing the urgent need to take prompt action to address climate change as a major cause of loss of biological diversity, which is already evident, in particular in coral bleaching, and its associated socio-economic consequences,

Also emphasizing that measures that may be taken to mitigate or adapt to climate change may also have important effects, positive or negative, on biological diversity,

Stressing the need for adaptation measures to ensure the long term integrity of ecosystems, species and ecological processes under conditions of climate change,

Emphasizing also the impact of biodiversity loss on climate change and the contribution that the conservation and sustainable use of biological diversity, inter alia, through avoided deforestation, could make to adapt to or mitigate climate change,

Stressing that overall emission reduction is the main and most important measure to address climate change,

Recognizing the existence of reliable scientific data that climate change is already impacting on the biological diversity of coral reefs,

1. *Recommends* to the Conference of the Parties at its sixth meeting that there is a need to take immediate actions under the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change to reduce and mitigate the impacts of climate change on the biological diversity of coral reefs and their associated socio-economic effects:

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[1] This annex has not been formally edited.

2. *Takes note* of the discussion of the interlinkages between biological diversity and climate change, contained in the discussion note by the Executive Secretary submitted to the Conference of the Parties to the United Nations Framework Convention on Climate Change at its sixth session and the UNFCCC Subsidiary Body on Scientific and Technological Advice at the second part of its thirteenth session, held in The Hague, from 13 to 24 November 2000 (UNEP/CBD/SBSTTA/6/11, annex I);

3. *Welcomes* the agreement of the Subsidiary Body on Scientific and Technological Advice to consider this matter at its fourteenth session, scheduled for July 2001, and its invitation to the Parties to the United Nations Framework Convention on Climate Change to submit their views on the issues identified;

4. *Promotes* on the basis of the ecosystem approach a wider assessment of the interlinkages between biological diversity and climate change, in order to develop more comprehensive scientific advice to integrate biodiversity considerations into the implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol, including:

(a) The impacts of climate change on biological diversity and the impacts of biodiversity loss on climate change;

(b) The potential impact on biological diversity of mitigation measures that may be carried out under the United Nations Framework Convention on Climate Change and its Kyoto Protocol, and identification of potential mitigation measures that also contribute to the conservation and sustainable use of biological diversity;

(c) The potential for the conservation and sustainable use of biological diversity to contribute to climate adaptation measures;

5. *Initiates*, as a first step in the wider assessment referred to in paragraph 4 above, a pilot assessment to prepare scientific advice to integrate biodiversity considerations into the implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol, and, for this purpose, establishes an ad hoc technical expert group in accordance with the modus operandi of the Subsidiary Body on Scientific, Technical and Technological Advice and the terms of reference provided in the annex to the present recommendation, to report on progress to the Subsidiary Body at its seventh meeting;

6. *Invites* the Intergovernmental Panel on Climate Change to contribute to this assessment process by preparing a technical paper and identifying experts;

7. *Invites* the Millennium Ecosystem Assessment to incorporate the issues identified in paragraph 4 above, and to report on this matter at the seventh meeting of the Subsidiary Body on Scientific, Technical and Technological Advice;

8. *Invites* the United Nations Framework Convention on Climate Change, as well as the Convention on Migratory Species, the Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar), the United Nations Convention to Combat Desertification, the Scientific and Technical Advisory Panel of the Global Environment Facility, the United Nations Forum on Forests and other relevant organizations to contribute to this work;

9. *Requests* the Executive Secretary, in consultation with the Secretariat of the United Nations Framework Convention on Climate Change, to explore the formation of a joint liaison group between the bureau members of the relevant subsidiary bodies of the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity, and their respective secretariats, for the purpose of enhancing coordination between the two conventions including exchange of relevant information, development of a joint work plan to address the interlinkages between climate change and biological diversity, and the organization of a joint workshop to further cooperation and collaborative action between the two conventions;

10. *Requests* the Executive Secretary to inform the secretariats of the United Nations Framework Convention on Climate Change, the Intergovernmental Panel on Climate Change and the Millennium Ecosystem Assessment of these steps taken by the Subsidiary Body on Scientific, Technical and Technological Advice, to convey to them the urgency and importance of the matter, and to invite their continued collaboration, with a view to facilitating the integration of biodiversity considerations in the implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol;

11. *Requests* the Executive Secretary to prepare a background paper for the pilot assessment referred to in paragraph 4 above, drawing upon the material in his note on biological diversity and climate change prepared for the sixth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (UNEP/CBD/SBSTTA/6/11);

12. *Notes* the importance of coordination of policies and programmes relating to climate change and biological diversity at the national level.

ANNEX

PILOT ASSESSMENT OF THE INTERLINKAGES BETWEEN CLIMATE CHANGE AND BIOLOGICAL DIVERSITY

Terms of reference of the ad hoc technical expert group established in paragraph 5 of recommendation VI/7

1. The ad hoc technical expert group should, on the basis of the ecosystem approach:

(a) Analyse possible adverse effects on biological diversity of measures that might be taken or are being considered under the UNFCCC and its Kyoto Protocol;

(b) Identify factors that influence biodiversity's capacity to mitigate climate change and contribute to adaptation and the likely effects of climate change on that capacity;

(c) Identify options for future work on climate change that also contribute to the conservation and sustainable use of biological diversity.

2. The ad hoc technical expert group should develop recommendations based upon a review of possible approaches and tools such as criteria and indicators, to facilitate application for scientific advice for the integration of biodiversity considerations into the implementation of measures that might be taken under the UNFCCC and its Kyoto Protocol to mitigate or adapt to climate change;

3. In carrying out these tasks, the ad hoc technical expert group should draw upon relevant documents prepared under the Convention on Biological Diversity (including decisions V/3, V/4, and V/6, and UNEP/CBD/SBSTTA/6/11) and IPCC (including the third assessment review and the *Special Report on Land Use, Land-Use Change and Forestry* (LULUCF)), as well as other available literature;

4. The ad hoc technical expert group should identify areas where further work is needed to improve scientific advice for the integration of biodiversity considerations into the implementation measures to mitigate or adapt to climate change, including (i) further assessment, drawing upon existing knowledge; and (ii) further research; and should identify options for participation of the IPCC and UNFCCC in this further work;

5. The ad hoc technical expert group will comprise a regionally balanced group with expertise in the fields of biological diversity and climate change. The experts will be selected by the Executive Secretary in accordance with the *modus operandi* of SBSTTA, in consultation with the SBSTTA Bureau, drawing upon experts nominated by Parties to the Convention on Biological Diversity, scientists involved in the IPCC processes, and experts from indigenous and local communities;

6. The work of the ad hoc technical expert group should be initiated as soon as possible. A progress report should be submitted to SBSTTA at its seventh meeting, and the results of the ad hoc technical expert group's work will be completed by the time of the eighth meeting of SBSTTA and considered by SBSTTA at a meeting prior to the seventh meeting of the Conference of the Parties.

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